"Theoretical Approach of Network Communication and Collaboration in Research"

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Abstract: Collaboration and cooperation in the virtual surround is one of the key elements in international cooperation research. This paper is about understanding functions of the virtual tools with the help of the Participation Theory of Communication (PTC). Various forms of the phenomena described as communication can all be characterized as being rooted in the need of the agents to recognize and/or to solve problems. Communication is a way of understanding the agent's behaviour as the potential ability to recognize and/or solve problems with the help of symbols (or signs). The basic theory is discussed and applied to the field of network-communication. The CooSpace as a real application - used in the CAENTI project - was built on the basis of theoretical conclusions. The web based applications can be described as a set of communication devices. Different communication devices have different characteristics. One of the most important factors of effective use of these devices is knowledge which helps the users (agents) to choose appropriate tools to solve their problems. CooSpace supposes self-motivated agents aiming to solve their problems. Usage is not important in itself. Usage is important only as a way of helping to increase the problem-solving capacity of the participants. The developers are working on improving the tools in the CooSpace system using valuable experience gained from the CAENTI project alongside scientific approaches.

1. INTRODUCTION

The main idea we are going to look at, is the role of information technology in scientific cooperation, and what the boundary conditions are that we must be aware of. The question seems to be simple but, as we shall see, after a short investigation into the terms used in the above sentence such as cooperation, science, technology, and information, a rather open discussion will follow. The information society and its essence has been one of the most often discussed contemporary topics since the early '60's. (Bell, 1979, Toffler 1980, Castells, 1996) On the other hand, information, culture, cooperation, and communication are also keywords of discussions being far from finished, and displaying quite a rich spread of opinions. The history of epistemology concerning the origin of knowledge touches the colourful images of what science is all about. Philosophers, taking an analytic, pragmatic or hermeneutic point of view, have different ideas about the status of knowledge and truth, therefore their concepts about the origin of meaning are also different. The anthropological approaches to the understanding of human society through culture (Boas, 1940) or through interpreting elements in structure (Lévi-Strauss, 1974) deploy a large variety of ways to the better understanding of a society. The term culture sometimes seems to be more complex than usable. Clifford Geertz (1973) called Taylor's definitions about the aspects of culture, a "mixed vegetable-soup by Taylor".

When taking into account more sources, one finds that science arises not only out of the essence of knowledge (disregarding the epistemological aspects) but also out of a socio-cultural process of societies. (Kuhn, 1962) The term, communication, mostly emerges from the fact that culture is being described. Culture could be understood as a construction made up of social interaction or, looking at it from another point of view, culture is a kind of knowledge that we use in communication. (Habermas, 1981).

2. COMMUNICATION THEORY USED

This short essay does not want to solve any of the above-mentioned problems, but it shows the complexity of the terms that we use. This paper is based on the Participation Theory of Communication (PTC) (Horányi, 1999). From this aspect, the various forms of the phenomena described as communication can all be characterized as being rooted in the need of the agents to recognize and/or to solve problems. Communication is a way of understanding the agent's behavior as a potential ability to recognize and/or solve problems with the help of symbols (or signs). The problem of the agents is a difference between the desired and therefore aimed state and the current state.

The basis of understanding patterns as symbols is common knowledge. The agents participate in this common knowledge, communio. Communio is not a factually existing phenomenon. It is strongly attached to an assumption of agents and to a concept which is about understanding some aspects of their behaviour. This kind of description titles their target as communication. The Participation Theory of Communication (PTC) (Horányi, 1999) is about describing a scale and topic and independent description of agents and their problem-solving capacity according to their preparedness. One possible "place" of problem-solving capacity is symbolic which results from the agents process of

signification in a given place and time. The constituents of symbolic are the signifier and signified as it is discussed with various terms in the literature of semiotics.

Patterns are differences in time and/or space accessible via modalities of perceptions. The patterns or structures of it – understood as problem solvers – are agents, while other patterns are recognized as symbols (or signs) or raw-patterns. Human agents in everyday situations are, firstly, participants in a communication as agents that give a potential subject to be understood by someone and, secondly, the human agents are able to understand their own or others' behaviour as participants in the communication.

Communication is not something that can be recognized as a force, as a process, or as an architectural or structural phenomenon that is independent of the supposition of an agent with teleological goals and with abilities to step forward. The agent as an assumption of willing power is not just a possible description of human but it can be applied to something that we can call collective or fictive. The assumption of the collective gives us a chance to understand organization also as an agent. The collective never appears on its own. Another agent behaves in the name of the collective. We can call this appearance, role. When G. H. Mead in the 30's presented the theories of social interactionism, he recognized the dynamics of building the aforementioned second ability. Mead (1934) also recognized the interactiveness of playing and tuning the roles at the same time.

There are two double agent-constellation aspects: mimetic and virtual. The mimetic double agent-constellation gives a model of the understanding of somebody who behaves like somebody else. We all know, in the theatre, actors play their lines, but we are concentrating on the character to appear. In the situation where we show an architecture (designed structure of physical elements), it seems to be or behaves like an agent, but this is virtual. Virtual and mimetic are not exclusive categories. We need a concept of agents in order to understand the surrounding patterns that are accessible via modalities of perceptions. The description of patterns is mostly about understanding agents that create a pattern or appear to do so.

3. COMMUNICATION DEVICES AND COMPUTERS

Understanding these patterns in many cases are based on the common knowledge about symbols (or signs) that are called communio. The patterns could be fixed for the future, transformed in space and amplified to overcome the limitations of perception. These architectures created for modification of accessibility of patterns are communication devices. They range from a simple amplifying-glass to complex television systems.

The most fundamental description of communication used, very often derived from a technological approach. The model C. Shannon (1948, 381) describes the schema of one general communication system where a well known transmitter and receiver are connected and the signal is carried the message trough channel is influenced by the noise. The approach Shannon described is the essential mathematical model communication crucial in signal processing technology. This approach is one of the most important theories in kibernetical tradition of communication but it describes signals without meaning. That is why, this theory has a little narrow focus on communication described: "The fundamental

problem of communication is that of reproducing at one point either exactly or approximately a message selected at another point. Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. The significant aspect is that the actual message is one selected from a set of possible messages. The system must be designed to operate for each possible selection, not just the one which will actually be chosen since this is unknown at the time of design." (Shannon 1948, 379) The reproduction of patterns is a logic of communication devices.

A computer network is not a communication device on its own. Applications (computer programmes) organize network and hardware infrastructure to become a communication device. The computer has a relatively free universal functionality. The use of a computer opens up many ways of use: it can mix a functionality of communication devices and/or can behave like an agent (as virtual agent). In the virtual agent concept we know it is not "real", but we want to apply the concept of an agent. By the universal computer theorem of Neumann it is obvious that the computer has the memory to admit programmes which partly determine the functionality of the architecture. (Aspray, 2004)

Communication devices are used and integrated very deeply in everyday life. Society and culture are strongly influenced and built by the way communication takes place. The use of computers and their networks give functional dynamics to communication devices. These changes make the information age. It creates a space of flowing information (Castells–Ince 2006 [2003], 60) as a new virtual platform of economical and social relevancies. The crossways of "real" space flows of raw-material, energy and people leads to the big and important cities of the today world. (Bell, 1979)

The various communication functions of the Internet as a social phenomena was a surprise for the first inventors. The history of e-mailing shows, how motivating and interesting it was to find new ways of communication via new software devices. Ray Tomlinson (young engineer in BBN) who created the e-mail in 1972 says: "It was just a hack. And the next step was to get other people to try using it, because so far I'd only sent mail to myself first and then to the other people in my group." (Segaller, 1998, 105) Len Kleinrock, professor of computer science at UCLA, former director of ARPAnet Network Measurement Center says: "...As soon as e-mail came on, it took over the network. We said, 'Wow, that's interesting.' We should have noticed there was something going on here. There was a social phenomenon that was happening." (Segaller, 1998, 105) The usage of computers and networks today are different from the dreams of pioneers. The most popular applications involving more and more users are about communication between people. The E-mail or MSN, Skype, ICQ, IRC or Chats, Forums and most of the interactive web is about each other. E-mail is the tool developed first, and it plays one of the most important role until now. In most cases the computer handles (transfers) patterns from one place to another, but the categories the digitalization process uses (frames, wave forms, letters) are far from the semantical structures. It means that in most cases the process, the computers go through is not about the meaning. In some cases – where data structures are defined – a chance is

given to building processes relevant according to the content. In database applications, search engines can offer patterns never composed by anyone.

The use of a communication device depends on how the agents understand it. Knowledge about the structure is how the patterns are transformed, fixed or amplified via the device with knowledge about pattern accessibility and the control mechanisms of the device.

Written text is one of the most important classes of symbols. Understanding language representation entity pattern as sign is not a simple following of a bijective relation between elements and meanings. The debate on meaning tends from the relatively strict point of view of the logical positivists (eg. Carnap, 1931) to the rather pragmatic rich concept of meaning (eg. Quine, 1951, 1961) focusing on the assertion here and now, or there and then. The meaning is contextual therefore it is crucial in collaborative virtual environments to represent scenes as the corner point for the signification efforts of agents.

From the theoretical approach, one tool is a separable end describeable structure of patterns transfer and access control mechanism. The one-to-one e-mail has characteristics we can analyse, but the use of distribution lists and automatically generated e-mail messages are different communication devices. The world-wide web is also a complex. The static web pages as composed and publicly accessible patterns draws characteristics as a communication device. The interactive web applications using database to store, reproduce and algorithmically compose content are a class of communication devices. Depending on the architecture, algorithm we can describe different tools. What are the general aspects of this description?

- What kind of patterns are handled by the communication device?
- What kind of knowledge is supposed?
- How does the actual device control, organise the access of patterns?
- What are the time and space characteristics of the communication device?
- Does the digitalization process deal with semantics?
- How effective is the transformation and transmission of patterns?

Some communication devices work with textual data, some others operate auditive or visual data depending on the modalities of perception involved. The users of the device have to understand the device. That means answers for aforementioned questions. The communication device architecture controls the access of information. There are some devices (architecture) where the functionality is about the control of access. The mailed closed envelope with its address of addressee and cultural regulations and a process of post are about who will receive physical access to a content of the envelope regardless of the patterns inside. Most letters have text inside, but we can send drawings or even a smelling perfume as well, but the envelope controls the access. Some tools are used to extend the access range of patterns. The amplifier helps the speaker to be accessible for larger audience. The information technology architectures control the access. The access includes possible ways of creating and “reading” the patterns created. The most important basis of this control is the user authentication of identified users. Depending on the identity and

rules, the decision about access control is authorization. In the case when the IT system has a relatively high number of named users and many accessible entities the setup and administration of access rights becomes difficult and a time-consuming process. The role based and content category based access control make it possible to manage systems such as scientific cooperation architectures.

The communication devices save the patterns against time. The tape recorder stores the sound and plays it back when needed. The mobile phone bridges the distance in space and repeats the sound patterns on both ends of the connection. The web applications support time and space characteristics as well. The chat as real-time, synchronic communication works against spatial distance. The forum stores the dialogue against time, but it also has a spatial dimension. One of the most interesting aspects of the analysation of communication tools is the question of digitalization. Digitalization is a decision about relevances, meaning we have to decide what is important and what is not important from the perceptible. If it is not possible to strictly distinguish between the important and the not important, we have to use units and categories making it possible to prolong these decisions. It is partly because of the theoretical hard questions about the intersubjective meaning and partly about when the architecture of digitalization is unable to recognize, or access the content regardless of the impossibility of the agent to read independently. The video recorder does not know anything about the pictures and the story. Recognition of a human face is quite a hard task for computers today. The video recorder uses frames one after the other quickly, but it is has no relation at all to categories of meaning. The sampling is not relevant in terms of semantics but fast enough to give a chance for viewers to recognize agents and patterns to be able to enjoy and understand the story. The typed text has letters and the words are separated with spaces and other punctuation symbols. The words are semantically relevant categories. This makes it possible for computers to build network search engines and serving pages containing the keyword we entered. The tagging of pages, XML/XSLT based web technology let the computers appear to be smarter at handling the content of web. The last aspect for discussion is the effectiveness of the communication tool. We have to evaluate effectiveness taking into account what the function of the communication device is. Lots of the devices we use, aim for the good (equal, similar) representation in comparison to the original. Many expressions show this: The camera has an “objective” to create a good quality picture. We like the CD player if it is HiFi (High Fidelity) quality. Music-fans criticize MP3 format music quality and they listen to audio format files without loss on appropriate equipment. Colour television is better than black&white. And HD standard video has a closer relationship to the original. The textual representation of information is special because it is very unusual to use as raw pattern. We handle text as symbolic and therefore composed pattern by an agent. In cases of other representation formats it is possible to switch off or simply forget the communication device and pattern appears to be raw perception with the relative freedom of understanding it as symbolic or not.

4. SCIENTIFIC COLLABORATION TOOLS

The research of network communication is not an independent disciplinary field. Theoretical approaches should be applied. Jonathan Sterne suggests (1999, 275): “Cultural

studies' critique of realism, and my support of it herein, would suggest that it is neither epistemologically sound nor politically desirable to just study "the Internet" in isolation from other cultural phenomena. Our fictional study, The Internet, might at this point no longer be a study of a medium itself but its place in everyday life."… "Internet research in general, needs to be further integrated with research on other, related phenomena." One important field where the computer based tools can take place is collaboration. "Collaboration is more than a popular buzzword dropped casually into organizational discourse, and more than the jargon used to describe joint software projects in the technology industry. In most communities today, it is a necessity for groups, organizations, and institutions to work together collaboratively to confront complex issues." (Heath et al. 2004, 189)

The significance of the information society lies in the fact that - thanks to the use of computers – communication devices are functionally dynamic. This feature of these devices enables them to meet new requirements very quickly. Parallel to this the preparedness of individuals is changing increasingly rapidly and sharply. The relevant preparedness tends to mean the ability to access and obtain preparedness itself rather than the ability to store information like an encyclopedia. This change is the key to the use of new technology. This approach to the information society gives an indication to design a new research and education system that is suitable for the mobilisation of skills. The research and education are in co-operation in the interest of common aims. In different scientific fields researchers use different methods and computer programs in research, but the communication between them is also very important. The history of Internet shows that the higher education institutions and research laboratories were the first real users of the network. One of the scientific collaboration tools we use in the CAENTI project is CooSpace.

5. DESCRIPTION OF COOSPACE

The developed CooSpace System is communication-centered. CooSpace is a web based application aiming to create a real situation in virtual surround. Real cooperation takes place on the virtual scenes of application. Participants are joined in the particular scenes through their roles. It is the participants' role to determine the tools used where participants can make appointments and organize their communication freely. The co-operation emerged of the common intent of the participants, but the scenes of the CooSpace are supporting the co-operation of the members of the groups by the ways of assuring numerous forms of communication between them. A situation is important because it selects the knowledge the communication is based on and it refers to the communio. A situation (scene) gives context to a symbolic representation of the problem-solving capacity accessible via the system. A scene is a virtual space of a real existing group. The users (agents) are the members of this group. It is an interesting feature of the cooperation scene that participants can form smaller groups that are allowed to create a subscene where the members of the group can work on a particular task on their own. CooSpace certainly provides participants with basic contact information (address, e-mail address), but the participants also have a possibility to upload their photos to make their relationships more

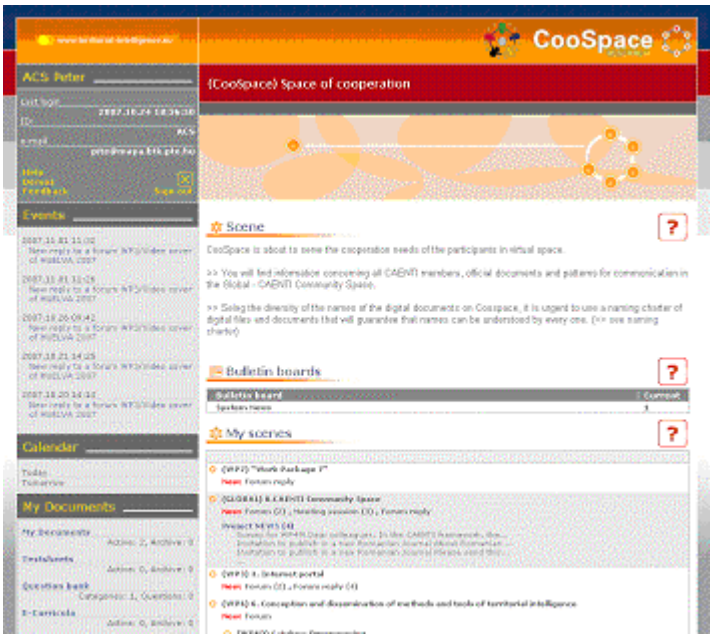
personal. CooSpace provides numerous ways of communication within the scene for the user of the co-operation – or in other terms, research – area. The users can proceed with dialogues, can discuss different topics in the frames of definable thematic forums (direct correspondence), or via chat (in real-time). It is possible to congregate virtual or personal meetings. With the help of the messaging system the personalised follow-up of the events and changes in the system is possible. With the use of e-mail messaging possibilities the users of the research area can earn knowledge of changes and events important to them.

The system gives possible, organized ways of co-operation for involved researchers and they can publish their achievements for the closer and the wider circle of researchers. The system of CooSpace supports the management of tasks emerging during the operation of a distinct (research) team/group. It is possible to appoint tasks for the whole group or for the specific members of the group, to send in the solutions for these tasks and to rate these solutions. One can set out deadlines to tasks, which appears in the time schedule of the scene. The calendar management gives an overview of the different tasks in the research areas. It is also possible to view a summary of the tasks and results, achievements of the scene which can be saved in a format available for other applications. Assignments can be provided and the papers can be "handed in" uploaded in a form of a file. Other participants can then evaluate these, but they can also produce an automatic-type test. In the communication of participants the synchronic and asynchronic services (chat-room, forums) used in traditional virtual classrooms are also available.

In a unified way the data of the education or research community can be accessed. The shared document storage provides an easily accessible, common system of the achievements, templates and semi-final documents. The distinct users can share documents, mediafiles and with the compilation of bibliographies they can set out curricula and working papers. Document is a complex element. CooSpace provides a possibility for registering data of documents and attaching files to them. The management of the documents is independent from the scene, but they can be connected to scene, that way creating the bibliography for that particular scene.

The system can handle zipped and uploaded static websites with an appropriate access control. Special zipped format SCORM compatible e-learning materials are also handled. The activation of the new document notification message helps the users to keep track of changes made. Another important tool is the simple messenger services used among the participants. Notification and exchange of information are also assisted by messages on automatically generated events. Regulation of access can ensure that confidential materials are available only for the people concerned. Other tools — not discussed deeply here — are also provided: test-banks and photo albums, blogs and linked external application module interface support, and a specially tuned mobil-browser interface. Each member of the group can enter this scene or subscene, where the activity is controlled by the user rights management. The rights of the distinct member (user) are defined by the relation (role) of this distinct member to the particular scene (researcher, teacher, student...).

Figure 1.



The design of the user interface is intuitive. On the user interface there are identifiable areas and icons to support the user in navigation. (Figure 1.) The CooSpace application is available in five languages and other translations are in progress.

6. EFFECTIVE USE

Effective knowledge is based on how the virtual scenes, as the representation of real word situations, are built up and are available to the users (agents) to solve their problems. Use of CooSpace requires self-motivated agents aiming to solve their problems. Usage is not important in itself. Usage is important only as a way of helping to increase the problem-solving capacity of the participants.

Aspects influencing the efficiency of tool (device):

- Using common language. (Not only an agreement, but the accessibility of symbolic.)
- Giving exact objectives for collaborators. (Sharing problems to solve.)
- Clear representation of real word context in the virtual surround. (To help recognition symbolic as a potential place of problem solving capacity.)
- Knowledge of system to help the users to utilize it for problem solving. (User training, for effective navigation and tool usage.)
- Giving good and appropriate variety of communication devices (tools) to use.

The development of the CooSpace recognizes the priorities above. In paralell the CAENTI project, thousands of Hungarian students are also using CooSpace. The researchers and

developers are working together to improve CooSpace to help the participants benefit more from the system. It could be done by broadening the content available and by having the potential users access the symbolic, serving the needs of the project and providing the participants with new tools. The tools concentrate on specific problems, giving a communication device which aims to be proper and recognized by the users.

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